NESTING BIOLOGY OF *HOPLITIS BISCUTELLAE* (COCKERELL) (HYMENOPTERA: MEGACHILIDAE)[1]

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ABSTRACT: The nesting biology of *Hoplitis biscutellae* (Cockerell) is described and illustrated. This species uses mud cells of *Sceliphron caementarium* (Drury) for nesting. Cell walls and plugs are of *Larrea tridentata* (Moc. & Ses.) flower parts, leaves and resin. Pollen provision and analysis shows a single source, *Larrea tridentata*. The bee overwinters in a cocoon as a post-defecating larva.

The genus *Hoplitis* Klug contains 45 species in the Nearctic, north of Mexico (Eickwort 1970, Michener 1968, Hurd and Michener 1955). Before 1975, biological information was known for 8 species (reviewed by Clement and Rust 1975). Since then information is available for 8 more species: *H. robusta* (Nylander) (Clement and Rust 1975), *H. hypostomalis* (Michener), *H. copelandica* (Cockerell), *H. abjecta* (Cresson) (Parker 1975[3]), *H. hypocrita* (Cockerell), *H. fulgida* (Cresson), *H. sambuci* Titus (Clement and Rust 1976), *H. enceliae* (Cockerell), *H. elongata* (Michener) (Parker 1977[3]).

The purpose of this paper is to report on the nesting biology of *Hoplitis (Dasyosmia) biscutellae* (Cockerell). This species presents several unusual nesting characteristics for any species of *Hoplitis,* namely the extensive use of *Larrea tridentata* (Moc. & Ses.) resin and plant parts in cell formation and closure. Hurd and Linsley (1975) report on the oligoletic relationship of *H. biscutellae* to *Larrea*. Stephen, et al. (1969), Linsley and MacSwain (1943), Parker and Bohart (1966, 1968) and Erickson, et al. (1976) provide additional accounts on the biology, parasites and predators of *H. biscutellae.*

Nest Site: An extensive nesting site of *Sceliphron caementarium* (Drury) was found on a slightly over hanging rock face near the northern Surprise Spring, 2Km east of the Grapevine Ranger Station, Death Valley National Monument, California (37°00'N - 117°20'W, elevation 853M). The nesting site occupied an area of some 25-30M^2 on the north to

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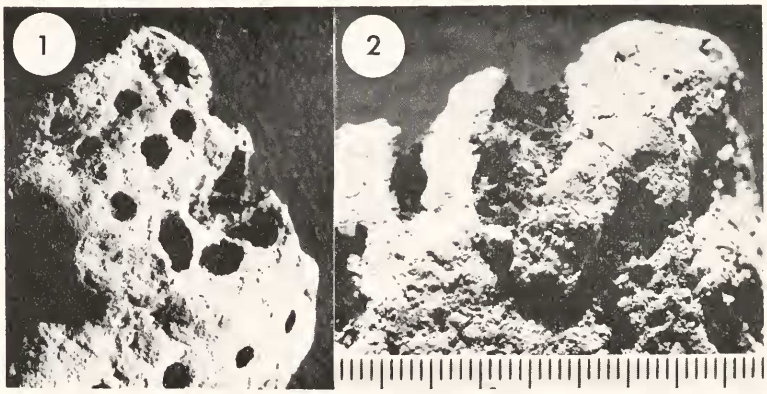
[3]Parker (1975,1977) reported the biological information under the generic name of *Anthocopa*. This is a familiar use of *Anthocopa*, since Michener (1968) has suggested *Anthocopa* be synonymized with *Hoplitis*. However, no formal synonymy based on a study of Holarctic fauna has been made, see Hurd (1979: 2020).

northeast exposure of the face. Lower portions of the nest complex had been washed away by earlier run-off waters. There was no nesting activity when the site was found in October 1978. Examination of the nest complex showed reuse of the *Sceliphron* nests by other insects. However, most reused nests had heavy signs of predation or parasitism. Three sections of relatively unattacked nests were removed and returned to the laboratory for examination and rearing. *Hoplitis biscutellae* and *S. caementarium* were the only Hymenoptera reared from the sections.

Nest and Cell Construction: Twenty cells of *Hoplitis biscutellae* were found in one of the nest sections (Figs. 1, 2). The other nest sections contained only *S. caementarium.* The 20 cells were located in 8 *S. caementarium* cells with a mean number of 3 cells per wasp cell (range 1-4). The bee cells were basically arranged in an oblique-linear series within the wasp cells. The wasp cells were not cleaned out nor did they appear to have been enlarged by *H. biscutellae.* Several wasp cells contained pieces of the wasp cocoon. Bee cells were composed of plant parts (petals, sepals and leaf pieces) mixed with plant resin. Comparison of the plant parts with herbarium specimens showed that the parts were from *Larrea tridentata,* creosote bush. The plant parts-resin mixture formed the rigid walls of the urn-shaped cells. The inner cell was smooth and polished and the outside rough and uneven. A mixture with less resin filled the spaces between the bee cells and the wasp cell wall (Fig. 2). The resulting cell wall varied from 0.5-1.5mm or even greater in thickness in the filled areas. In several bee



Figs. 1 and 2. Nesting biology of *Hoplitis biscutellae* Cockerell. Fig. 1-Outer surface of *Sceliphron caementarium* (Drury) nest containing *Hoplitis biscutellae* nests. Fig. 2-Inner surface of the same nest section showing the resin-plant part of cell walls of one *Hoplitis biscutellae* nest.

cells, pieces of the *S. caementarium* cocoon were worked into the cell wall. The cell cap was a smooth, concave resin plug about 1mm thick, lacking plant parts. Seventeen measurable cells were 9.7±0.14mm (S.E.) long, 5.8±0.12mm greatest diameter, with 5.0±0.08mm openings (cell caps). The last cell in a series was capped and this cap formed a simple nest plug.

Stephen, et al. (1969) mentioned the repeated use by *H. biscutellae* of *S. caementarium* cells, as many as eight times.

Provisions: One cell contained an uneated pollen-nectar mass. The provision filled the bottom 2/3 of the cell and was yellow-orange in color. The mass was very sticky and tacky when the cell was opened in January 1979. Comparison of the cell pollen with pollen from herbarium specimens of *Larrea tridentata* showed that they were the same. Several samples of the cell pollen showed 100% *Larrea* pollen. Examination of pollen grains from fecal pellets from other bee cells also showed *Larrea* pollen.

Feces: The feces of *H. biscutellae* were 0.2-0.3mm wide and 1.0-1.2mm long and slightly curved. They were orange to red-brown and had a shallow groove along the long axis. Intact pellets were found in the top portion of the cell. Laterally and in the cell bottom the fecal pellets were smeared onto the cell wall forming a layer approximately 0.5-1.0mm thick. This fecal layer appears to have an inner coating of larval salivary secretion that produced a relatively hard, uniform layer. When intact fecal pellets and pieces of the fecal layer were placed in 70% ethanol, the fecal pellets dissolved without teasing; whereas, the fecal layer retained its shape and only broke up with teasing.

Cocoon: The cocoon of *H. biscutellae* was composed of two layers, the outer being associated with the fecal layer. The inner layer was thin, light brown to tan matrix with numerous white silk threads visible in it. At its apex, the cocoon was formed by a dense layer of whitish-orange silken threads that formed the upper 0.5-0.8mm of the cocoon. When this layer was removed, there was a small, slightly raised "nipple" area on the top of the inner cocoon.

Development: When the nest was opened in January, the bees were post-defecating larvae. The larvae were given a cold treatment (5°C) for 90 days and then placed at room temperature (20°C). Eight of the nine larvae pupated in an average of 22.1±1.1 days after warming began and 20.4±0.5 days later they emerged. All eight were females. The ninth larva remained alive (active) and was placed back in cold treatment in December 1979. It was removed from cold treatment on March 28, 1980 and pupated on April 17, 1980, the second season.

Nest Associations: Three of the cells contained meloid larvae (reared

to *Nemognatha* sp.), 2 cells contained bombyliid larvae (reared to *Anthrax* sp.), 2 cells contained a clerid larve (*?Trichodes* sp.) and 1 cell contained an unknown larval hymenopterous parasite (?*Montodontomerus*). Exuviae of dermestid larvae were found in one of the empty cells associated with active bee cells.

Linsley and MacSwain (1943) reported the attack of *Trichodes ornatus* on *H. biscutellae.* Parker and Bohart (1966, 1968) found *Nemognatha macswaini* Enns, *Anthrax irroratus* Say, *Stelis* sp. (Megachilidae), *T. ornatus, Cymatodera* sp. (Cleridae) and woodpeckers as parasites and a predator of *H. biscutellae.* Erickson, et al. (1976) also reported *N. macswaini* association with the bee.

Discussion: The nesting biology of *H. biscutellae* has several unusual features when compared to other species of *Hoplitis.* Characteristic of *H. biscutellae* is the extensive use of *Larrea* resin in cell construction; no other North American *Hoplitis* thus far studied uses resin in cell wall and cell cap formation. Resin and incorporated materials are the nesting materials of other megachilid genera, e.g. *Chalicodoma, Trachusa, Dianthidium,* and *Chelostoma.* The presence of a weakly developed "nipple" on the cocoon top is unusual. Most *Hoplitis* cocoons have either a well-developed nipple *(H. hypocrita, H. fulgida, H. hypostomalis)* or they lack one *(H. sambuci, H. robusta, H. copelandica, H. abjecta, H. elongata).* Parker (1977) reports that *H. enceliae* has a "flat or slightly raised area (nipple) distinct from the surrounding surface". The formation of complete cells inside existing burrows by *H. biscutellae* is similar to *H. hypostomalis,* another hot desert species, and *H. copelandica,* a mountain species. *Hoplitis abjecta* and *H. elongata* form complete cells in exposed sites. The extensive use of *Larrea* products (pollen, ?nectar, resin, flower parts, etc.) in nesting may represent the narrowest relationship of any *Hoplitis* species. *Hoplitis abjecta, H. elongata* and *H. enceliae* appear to be oligoletic on *Penstemon* and *Encelia,* respectively.

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BOOK REVIEW

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illustration. Even though size is given in numbers beneath each illustration, use of a more realistic illustration scale or, at the very least, use of a uniform scale line for all illustrations would have helped to better visually interpret relative size. This is especially true for beginners, for whom this book is primarily intended.

The placement of illustrations in relation to their key words, specific names and descriptions is quite confusing and nowhere nearly as easy to follow as in the earlier edition where the illustrations were cut into the left hand margins of the descriptive material immediately below the key words. This is particularly true when the key words and specific name are on the lower half of a column, followed by a substantial blank space and then the reader must go to the top of the next column or to the top of the next page to connect the illustration and description to the key words. If the publisher had not been so rigid in its illustration parameters, much of this confusion could have been avoided by the use of modified picture sizes and, in addition, a great deal of waste space could have been conserved.

In general, the authors have done a commendable job with this revised edition. I wish I could say as much for the publisher whose policies re illustrations and format size (not as convenient to use as earlier edition) together with those almost inadvertent typos (pg. viii, line 13, Beetles; pg. 1, 1.9. wing; pg. 1, 1. 18. animals or; pg. 3. 1. 38 weight) leave considerable to be desired. In spite of these deficiencies, the text is a worthwhile addition to the library of all coleopterists.

H.P.B.